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Influence of fluctuating initial-state shape deformations in ultra-central collisions

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It is a long standing puzzle that hydrodynamic calculations give larger elliptic flow for ultra-central Pb+Pb events than experiments. One explanation is that sampling from a single particle distribution in Glauber model generates too much shape fluctuation, which can be expected to be modified by NN correlations. We study the fluctuation of shape-deformation as currently implemented in MC-Glauber-like models and its consequences on the magnitude of eccentricities. We show that for both deformed and spherical species, there are large fluctuations in the deformation that emerge event-by-event. For each nucleonic configuration, we characterize the deformation with parameters β and γ, calculated using quadruple moments. The second order eccentricity ε_2 shows a strong correlation with the E-by-E deformation β's for ultra-central collisions. We further show, via acoustic scaling, with a moderate reduction of β by rescaling, the eccentricities we get then agree with the measured values of v_n, for all experimentally available centrality bins. Therefore, the model provides eccentricities that describe experimental data, both where geometry dominates and where fluctuation dominates. We further show that this modification has important implication for the novel observable, the dependence of mean p_T of v_2, for ultra-central collisions.

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